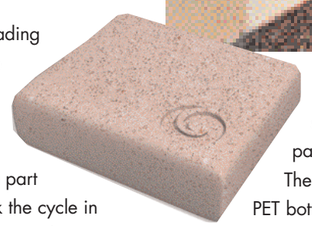
Breakthrough extrusion process helps to turn used plastic bottles into luxury worktops

Turned to stone

Technology developed by Shell, and now being commercialised under a Shell-backed venture capital programme, could offer a new sustainable outlet for millions of plastic bottles discarded every year. The process, which converts the used PET packaging into high performance extruded engineered stone, offers an additional recycling stream for the polyester value chain.

The drive to find new uses for plastics waste is intensifying as the pressures of reducing cardon dioxide (CO_2) emissions, meeting tougher recycling targets, and making better use of finite resources collide with the increasing demand for plastic packaging coming principally from developing economies.

PET bottles are one of the fastest growing and most widely used forms of plastics packaging, which means the problem of dealing with post-consumer waste is also growing. Although PET bottles can be re-used a number of times, due to quality degradation they eventually end up in landfill sites or are incinerated with or without energy recovery.



Echotect worktops have the aesthetic appeal of natural stone but the practicality of plastic.

As one of the world's leading suppliers of monoethylene glycol (MEG), the principal raw material for PET and other polyesters, Shell has been part of industry efforts to break the cycle in which today's useful packaging becomes tomorrow's waste problem.

But what started more than 10 years ago as an informal discussion over lunch by a group of chemical researchers at Shell's Amsterdam Research and Technology Centre is on the verge of becoming a breakthrough technology that could make a significant contribution to a more sustainable PET packaging value chain.

The technology uses waste PET bottles as a binder to produce advanced engineered stone for creating luxury kitchen and bathroom countertops or as an alternative to ceramic floor and wall tiles.

The manufacturing process, which involves a unique extrusion technique, has been developed and refined through years of laboratory testing. As a result of that work a new company, called Echotect, has been formed under a Shell-backed technology venture fund, to commercialise the process and bring its innovative products to the building materials market.

Stephen Eastwood, the company's Chief Executive, says: "The Echotect process provides a high value outlet for waste PET bottles through a clean, sustainable technology. It results in products that meet or exceed the performance of both natural stone and current engineered materials in what is an expanding global market."

He says the market for engineered →

stone products is growing at around seven percent per year as they take an increasingly larger share at the expense of natural stones and laminates because of their design flexibility and performance.

Eastwood, who has a background in the chemicals and building materials industries, says the technology itself could be attractive to players already in the engineered stone market. "It has some key advantages over current manufacturing processes because it involves no hazardous materials and generates very little waste," he says.

"With Western Europe producing around one million tonnes of waste PET every year alone, there's no shortage of raw material.

"It's unusual in the building products industry that you can produce a virtually identical product via a completely different process. It's a more sustainable model, which fits with current industry trends."

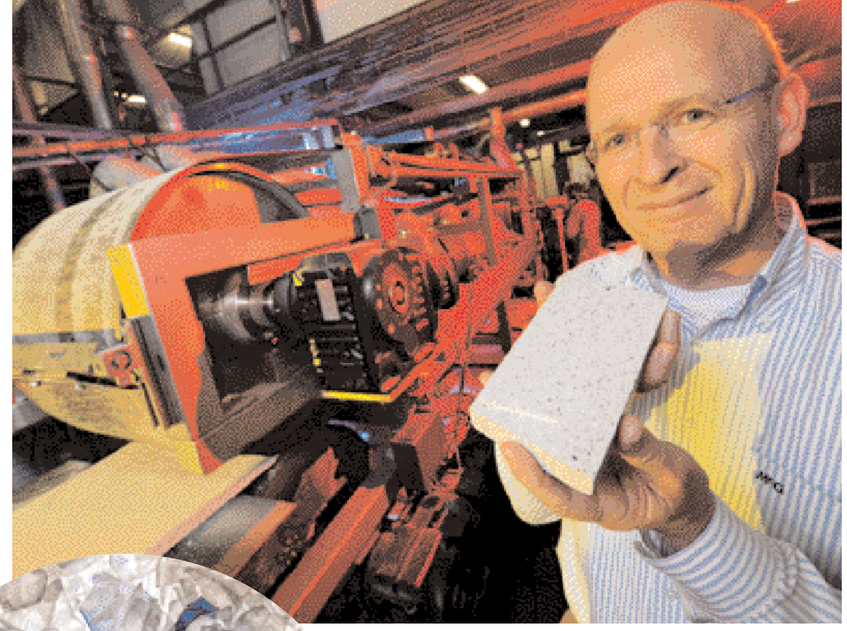
He adds that the Echotect technology would be relatively easy to retrofit to existing to existing production facilities.

A market development manufacturing facility established in The Netherlands is being used to prove the Echotect process on a semi-commercial scale.

"This is about a quarter of world scale production, which is large enough to demonstrate the viability of the process and to deliver sufficient material for sale, to demonstrate the quality of the products," says Eastwood.

Aad van Helden one of the original Shell development team at Amsterdam, now provides independent technical support to Echotect. He says that the PET-based extruded stone can compete directly with the best engineered materials currently available.

"The products look, feel and perform like real stone, which



Aad van Helden, one of the original Shell development team and now technical consultant to Echotect, examines the results of early production trials in The Netherlands.

Stephen Eastwood, Chief Executive of Echotect: the process, which uses waste plastic bottles, offers a more sustainable model for the engineered stone market.

With Western Europe producing around one million tonnes of waste PET every year alone, there is no shortage of raw material.

are the aesthetic qualities required by the luxury countertop market," he says. "Unlike stone, however, they are non-porous and have the stain resistance and easy cleaning qualities of a plastic.

"The process also has a lot of flexibility in terms of visual appearance, allowing a wide variety of stone-like colours and patterns to be created. Without the unavoidable variation of natural materials, these engineered designs can be replicated endlessly."

In the manufacturing process, the shredded PET bottle waste is mixed with fillers and either powdered quartz or marble. The Echotect products, marketed as Echoroc, Nuroq and Mixroq, can contain up to 15% PET.

The raw materials are combined in a special low shear extruder that allows mixing at high temperature – up to 300°C – without degrading the quality of the plastic. The molten material is then extruded into flat sheets and solidifies when cool. It can then be cut, shaped and polished like natural stone.

CHEMICAL STABILITY

"Control of the temperature and mixing is key to the final properties," says van Helden. "Technically, Echotect materials have excellent chemical stability and mechanical strength. This allows for the production of thinner slabs that are lighter to transport and open up opportunities for wall and floor tile applications.

"The products themselves are easier to work with and install because they only require simple, low cost cements rather than the specialty adhesives needed for comparable engineered stones."

Another technically attractive aspect of the technology is its ability to use low-grade PET waste as a raw material (see box). There is also far less waste generated in the production.

"Conventional engineered stones and solid surfaces are thermosets, formed by chemical reaction, which means once it's made there is little more you can do with it," explains van Helden.

"Because Echotect products are thermoplastic, they can be broken up and melted down for re-use. This means that both production and post-use waste can be recycled back into the manufacturing process, leaving very little scrap."

> "Because Echotect products are thermoplastic they, and any production waste, can be broken up and melted down again for re-use"

The recycling option could potentially open up new sales models for the counter-top market. "I can easily imagine a future model in which consumers could buy Echotect products on a return and exchange basis," says Eastwood.

In the meantime ongoing production trials involve making progressively larger slabs of Echotect materials applicable to commercial products. If the trials proceed as expected the unit could be in full production by mid 2009.

SUSTAINABLE LIFE-CYCLE

"With recycling targets only getting higher, the Echotect process provides a real opportunity to reduce PET waste through a clean, sustainable and commercially viable process," he says.

"We believe both the products and the technology will attract a lot of interest from the building materials industry."

Herman de Jongste, Shell Chemicals EO/Glycols Business Manager for Europe/Africa, says: "Plastics waste is a concern for all players in the glycols value chain, particularly as the versatility of PET is driving its increasing use in packaging applications.

"There may be no single solution but innovative technologies such as Echotect will make a valuable contribution to a more sustainable product life-cycle."

MORE OPTIONS FOR PET RECYCLING

A major technical advantage of the Echotect process is its ability to use the relatively low quality PET waste currently available through municipal recycling schemes.

This waste is typically mixed and contaminated with other plastic feedstocks, which would otherwise be a technical barrier to re-use.

The presence of PVC, for example, can spoil many potential re-uses for recycled PET because many applications require no more than 50 parts per million PVC content. This level of purity is both costly and technically difficult to achieve.

Echotec products, however, can accommodate much higher levels of PVC contamination typically found in existing recycling streams, without the need for complex and expensive separation processes.

This offers a new viable re-use for contaminated recycled PET waste, and at the same time ensures a cost-competitive source of raw material for Echotect production.

For more information about Shell Chemical glycols visit:
shell.com/chemicals/glycols